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A High Performance Binary Data Compression Technique Using Low Puncturing Turbo Codes

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***Abstract*— In this paper, we present a distributed coding technique for binary data compression. The performance of the proposed architecture is higher when compared with the existing techniques. The complexity of the traditional encoder is distributed to the decoder. Thus the proposed architecture can be used for the applications where the complexity of decoder can be more than that of an encoder.**

***Index Terms*—Distributed coding, Binary compression, side information, encoder.**

I. INTRODUCTION

Data compression is a key element to improve performance in communications and data storage systems. Although the proposed approach can be extended to nonbinary sources, for simplicity, we will focus on the case of data compression for binary memoryless sources. Therefore, we will consider the i.i.d. sequence which takes values with probability. It is well known that the sequence can be losslessly compressed up to a total rate of, where represents the source entropy [5].

Different schemes can be utilized to perform compression. The use of punctured turbo codes and modified iterative decoding schemes has been already dealt with. We will show that these techniques, originally proposed for channel coding, can also be used in the context of source coding to perform data compression. This occurs even when the source parameters are unknown at the encoder and decoder sites. As when they are applied for channel coding, the good performance of punctured turbo codes as source codes can be intuitively explained by their capability of generating random like codewords [6].

The proposed system is a fix-length-input to fix-length-output compression scheme, achieving near lossless compression at rates close to the theoretical limits. As opposed to other fix-to variable and variable-to-fix schemes, most of the complexity in the proposed scheme lies in the decoder site (the complexity of the encoder is very low). Its fix-to-fix character makes it especially suitable for joint source-channel coding applications. The work presented in this paper is related to, where we showed how to use turbo-like codes to perform compression and joint source-channel coding of correlated sources [8]. However, the specific details and the resulting performance in both contexts are different.

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II. PROPOSED ARCHITECTURE

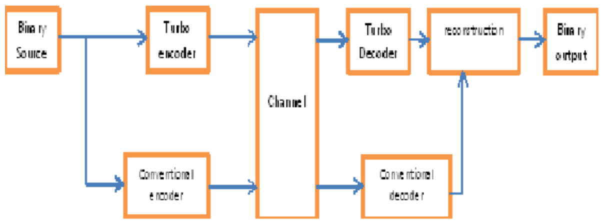

Figure 1: Block Diagram of the proposed architecture

III. SOURCE ENCODING UTILIZING PUNCTURED TURBO CODES

The binary source is divided in blocks of length L and encoded using a punctured turbo encoder. We utilize a standard turbo encoder, consisting of two constituent convolutional encoders and one interleaver of length. The puncturing scheme is adjusted to achieve the desired compression rate. In order to obtain a balanced compressed bit stream (i.e., similar number of zeros and ones), the puncturing is performed by completely eliminating the systematic bits. Although the puncturing scheme utilized for the coded bits is not critical, we have noticed that, in general, for rates close to 1 it is better to utilize pseudo-random puncturing of the coded bits (which implies that the coded bits utilized in the compressed sequence are not equally separated in the corresponding trellis). When the rate becomes smaller, structured puncturing, in which all coded bits in the compressed sequence are equally spaced in the corresponding trellis, achieves better performance. Notice that the parameter is not utilized in the encoding process [8].

The decoding method is almost the same as in standard turbo decoding: Extrinsic information is interchanged between constituent decoders and (corresponding to constituent encoders and). The only difference in our scheme, besides the fact that no noise exists here, is that the a priori probability of the input bits (and) has to be properly considered in the decoding process.

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In the case in which parameter is unknown at the decoder, it is still possible to perform compression. The idea is to estimate in each one of the decoding iterations, and to use this estimation as the true value of during the next iteration. This can be done by averaging the probability value of each one of the information bits obtained after a given iteration.

The turbo decoder combines the side information and the received parity bits to recover the symbol stream.

IV. RESULTS

A stream of 1048576 binary values were produced from the source.

1 0 1 1 0 1 1 1 0 0 0 1 1 0 1 1…….

These binary values are encoded using conventional encoder to obtain the following values:

1 1 0 1 1 1 1 0 0 0 1 1 1 0 1…….

These values when transmitted through the channel with a pre-determined variance value, the following values were obtained:

1.296, 1.068, 0.490, -0.997, 1.044, 0.832, 0.874, 1.017,-0.651, 1.290,-0.738,-1.171,-1.119,-1.158,-1.008…..

The input binary values are also encoded using Turbo codes to obtain the following values:

1 1 1 -1 1 1 1 1 1 1 -1 1 -1 -1 1 1…….

The output of a conventional decoder is as follows:

0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 ……

The value obtained from conventional decoder behaves as a side information to that obtained from Turbo decoder. The two streams are used further combined to obtain a stream of binary values which would approximately match the input stream.

1 0 1 1 0 1 1 1 0 0 0 1 1 0 1 1…….

Error rate calculation for different values of variance of the channel is tabulated as below:

TABLE 1: ERROR RATE FOR DIFFERENT VALUES OF VARIANCE

Variance	Error rate
0.079	0.5275
0.5	0.5106
1	0.5031
2.5	0.5001

V.CONCLUSION

In this paper, we reported the investigation about the behaviour of turbo coding with puncturing. A low punctured turbo codes and zero motion skip encoding strategy for distributed coding for binary data was presented. The generation of side information and the design of the punctured turbo codes can be integrated to improve the overall coding performance. Low level of encoder complexity is proposed. The proposed architecture gives a better performance than conventional intraframe coding at low complexity.

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